

WHAT IS CLAIMED IS:

1 1. A method of measuring an injection lock frequency range for an
2 integrated circuit having a first voltage-controlled oscillator and a second voltage-
3 controlled oscillator, the method comprising the steps of:

4 applying a control voltage to an input of the second voltage-controlled
5 oscillator such that an output frequency of the second voltage-controlled oscillator
6 locks to an output frequency of the first voltage-controlled oscillator; and

7 varying the output frequency of the first voltage-controlled oscillator
8 until the output frequency of the second voltage-controlled oscillator falls out of lock
9 with the output frequency of the first voltage-controlled oscillator.

1 2. A method as in claim 1,

2 wherein the step of applying the control voltage to the input of the
3 second voltage-controlled oscillator involves the step of switching the input of the
4 second voltage-controlled oscillator from an output of a low pass filter to a control
5 signal to which the control voltage is applied.

1 3. A method as in claim 2, wherein the step of applying the control
2 voltage to the input of the second voltage-controlled oscillator further involves the
3 step of:

4 monotonically changing the control voltage until the output frequency of
5 the second voltage-controlled oscillator locks to the output frequency of the first
6 voltage-controlled oscillator.

1 4. A method as in claim 1,

2 wherein the first voltage-controlled oscillator is an element of a first
3 phase-locked loop.

1 5. A method as in claim 4, wherein the step of varying the output
2 frequency of the first voltage-controlled oscillator involves the step of:
3 changing a frequency of an input stream to the first phase-locked loop.

1 6. A method as in claim 5,
2 wherein the second voltage-controlled oscillator is an element of a
3 second phase-locked loop.

1 7. A method of computing an injection signal power within a
2 voltage-controlled oscillator on an integrated circuit, the method comprising the steps
3 of:
4 determining an injection lock frequency range of the voltage-controlled
5 oscillator;
6 determining a que of an LC tank within a voltage-controlled oscillator;
7 determining a free-run frequency of the voltage-controlled oscillator;
8 determining a free-run output power of the voltage-controlled oscillator;
9 and
10 calculating an injection signal power value proportional to a product of a
11 square of the injection lock frequency range, a square of the que, and the free-run
12 output power of the voltage-controlled oscillator divided by a square of the free-run
13 output frequency of the voltage-controlled oscillator.

1 8. A method as in claim 7, wherein the step of determining an
2 injection lock frequency range comprises the step of measuring an injection lock
3 frequency range of the voltage-controlled oscillator.

1 9. A method as in claim 8, wherein the step of measuring the
2 injection lock frequency range of the voltage-controlled oscillator comprises the steps
3 of:

4 applying a control voltage to an input of the voltage-controlled oscillator
5 such that the output frequency of the voltage-controlled oscillator locks to an output
6 frequency of another voltage-controlled oscillator on the integrated circuit; and
7 varying the output frequency of the voltage-controlled oscillator until
8 the output frequency of the voltage-controlled oscillator falls out of lock with the
9 other voltage-controlled oscillator.

1 10. A method as in claim 9, further comprising the steps of:
2 wherein the step of applying the control voltage to the input of the
3 voltage-controlled oscillator involves the step of switching the input of the voltage-
4 controlled oscillator from an output of a low pass filter to a control signal to which the
5 control voltage is applied.

1 11. A method as in claim 10, wherein the step of applying the control
2 voltage to the input of the second voltage-controlled oscillator further involves the
3 step of:
4 monotonically changing the control voltage until the output frequency of
5 the second voltage-controlled oscillator locks to the output frequency of the first
6 voltage-controlled oscillator.

1 12. A method as in claim 7,
2 wherein the other voltage-controlled oscillator is an element of a first
3 phase-locked loop.

1 13. A method as in claim 12, wherein the step of varying the output
2 frequency of the other voltage-controlled oscillator comprises the step of:
3 changing a frequency of an input stream to the first phase-locked loop.

1 14. A method as in claim 13,
2 wherein the voltage-controlled oscillator is an element of a second
3 phase-locked loop.

1 15. A method of reducing an injection lock frequency range of a
2 second voltage-controlled oscillator in an integrated circuit having first and second
3 voltage-controlled oscillators, the method comprising the steps of:

4 measuring an injection lock frequency range of the second voltage-
5 controlled oscillator; and

6 increasing a free-run output power of the second voltage-controlled
7 oscillator.

1 16. A method as in claim 15, wherein the step of measuring the
2 injection lock frequency range of the second voltage-controlled oscillator comprises
3 the steps of:

4 applying a control voltage to an input of the second voltage-controlled
5 oscillator such that an output frequency of the second voltage-controlled oscillator
6 locks to an output frequency of the first voltage-controlled oscillator; and

7 varying the output frequency of the first voltage-controlled oscillator
8 until the output frequency of the second voltage-controlled oscillator falls out of lock
9 with the output frequency of the first voltage-controlled oscillator.

1 17. A method as in claim 16,

2 wherein the step of applying the control voltage to the input of the
3 second voltage-controlled oscillator involves the step of switching the input of the
4 second voltage-controlled oscillator from an output of a low pass filter to a control
5 signal to which the control voltage is applied.

1 18. A method as in claim 17, wherein the step of applying the control
2 voltage to the input of the second voltage-controlled oscillator further involves the
3 step of:

4 monotonically changing the control voltage until the output frequency of
5 the second voltage-controlled oscillator locks to the output frequency of the first
6 voltage-controlled oscillator.

1 19. A method as in claim 16,
2 wherein the first voltage-controlled oscillator is an element of a first
3 phase-locked loop.

1 20. A method as in claim 19, wherein the step of varying the output
2 frequency of the first voltage-controlled oscillator involves the step of:
3 changing a frequency of an input stream to the first phase-locked loop.

1 21. A method as in claim 20,
2 wherein the second voltage-controlled oscillator is an element of a
3 second phase-locked loop.

1 22. A method as in claim 15, wherein the step of increasing the free-
2 run output power of the second voltage-controlled oscillator is accomplished by
3 increasing a signal amplitude of the second voltage-controlled oscillator.

1 23. A method as in claim 15, wherein the step of increasing the free-
2 run output power of the second voltage-controlled oscillator is accomplished by
3 reducing a loading of an output signal of the second voltage-controlled oscillator.

1 24. A method as in claim 19, further comprising the step of:
2 increasing a loop bandwidth in the first phase-locked loop.

1 25. A method as in claim 24, wherein the step of increasing the loop
2 bandwidth in the first phase-locked loop is accomplished by increasing a pass band of
3 a loop filter within the first phase-locked loop.

1 26. A method of reducing intermodulation between a first voltage-
2 controlled oscillator (VCO) in a first phase-locked loop (PLL) and a second VCO in a
3 second PLL, comprising:

4 measuring an injection lock frequency range of the second VCO with
5 respect to the first VCO;

6 measuring a signal power of the second VCO;

7 determining a crosstalk power between the first and the second VCOs
8 using the measured injection lock frequency range and the measured signal power of
9 the second VCO; and

10 adjusting a signal power ratio between the first VCO and the second
11 VCO to reduce intermodulation.

1 27. The method of claim 26 further comprising adjusting a loop
2 bandwidth of the first PLL relative to that of the second PLL to reduce
3 intermodulation.

1 28. The method of claim 27 wherein the first PLL is part of a
2 transmitter and the second PLL is part of a receiver, and wherein the step of adjusting
3 a signal power ration comprises increasing a power of the first VCO relative to that of
4 the second VCO.

1 29. The method of claim 28 wherein the step of adjusting a loop
2 bandwidth comprises increasing a loop bandwidth of the second PLL relative to that
3 of the first PLL.

1 30. A transceiver circuit comprising:
2 a transmitter having a first phase-locked loop (PLL), the first PLL
3 having a first voltage-controlled oscillator (VCO);
4 a receiver having a second PLL, the second PLL having a second VCO;
5 and

6 a parasitic loop that couples signals between the transmitter and the
7 receiver causing intermodulation,
8 wherein, the first VCO is configured to have a different power level
9 relative to that of the second VCO to reduce the intermodulation.

1 31. The transceiver of claim 30 wherein the first VCO is configured
2 to have a power level that is greater than that of the second VCO.

1 32. The transceiver of claim 30 wherein the first PLL is configured to
2 have a bandwidth that is different than a bandwidth of the second PLL.

1 33. The transceiver of claim 32 wherein the second PLL is
2 configured to have a bandwidth that is greater than the bandwidth of the first PLL.

1 34. The transceiver of claim 31 wherein the second PLL is
2 configured to have a bandwidth that is greater than a bandwidth of the first PLL.